

CLAIMS

1. A substrate transportation apparatus (30, 31) for transporting substrates through feeding substrates (3, 3A, 3C) to a component mounting apparatus (101) which mounts a plurality of components (2) on the substrates and offers the substrates as component-mounted substrates (3, 3B, 3D), and through discharging the component-mounted substrates from the component mounting apparatus, comprising:

a loader unit (32) for loading the substrate along a substrate-transportation direction (B) so that the substrate is positioned in a first substrate position out of the first substrate position (P1), a second substrate position (P2), a third substrate position (P3) and a fourth substrate position (P4), each of which is assigned sequentially next to each other;

an unloader unit (34) for unloading the substrate positioned at the fourth substrate position from the fourth substrate position;

a substrate feed holder (36, 37) for releasably holding the substrate positioned at the first substrate position and then transferring the substrate to the second substrate position;

a substrate discharge holder (38, 39) for releasably holding the substrate positioned at the third substrate position and then transferring the substrate to

the fourth substrate position;

a holder moving unit (40) for moving the substrate feed holder and the substrate discharge holder in vertical direction and along the substrate-transportation direction; and

a substrate holding-and-moving device (26 and 28) for releasably holding the substrate and moving the held substrate to a substrate mounting region (P0) in which component mounting in the components mounting apparatus is performed, the second substrate position and the third substrate position, respectively.

2. The substrate transportation apparatus as defined in Claim 1, further comprising a control unit which is operable to control respective holding operations of the substrate feed holder and the substrate discharge holder, a movement operation of the holder moving unit and a movement operation of the substrate holding-and-moving device, and which controls the respective operations such as holding, by the substrate discharge holder, the component-mounted substrate from the substrate holding-and-moving device positioned at the third substrate position, discharging the component-mounted substrate from the substrate holding-and-moving device, moving the substrate holding-and-moving device to the second substrate position, feeding, by the substrate feed holder, the substrate to the substrate

holding-and-moving device, moving the substrate holding-and-moving device to which the substrate has been fed to the substrate mounting region, and moving the component-mounted substrate held by the substrate discharge holder to the fourth substrate position.

3. The substrate transportation apparatus as defined in Claim 1, wherein the substrate holding-and-moving device is operable to move the held substrate in a direction (X) along the substrate-transportation direction which is a direction along a surface of the substrate and in a direction (Y) almost perpendicular to the transportation direction.

4. The substrate transportation apparatus as defined in Claim 1, wherein the holder moving unit is operable to switch a speed or an acceleration of the movement depending on whether the substrate discharge holder is in a state of holding the component-mounted substrate or not, and

a speed or an acceleration of the movement when the substrate discharge holder is in the holding state is smaller than a speed or an acceleration of the movement when the substrate discharge holder is not in the holding state.

5. The substrate transportation apparatus as defined in Claim 4, wherein the speed of the movement when the substrate discharge holder is in the holding state is a

speed which allows to prevent components mounted on the component-mounted substrate from suffering displacement of mounted positions.

6. The substrate transportation apparatus as defined in Claim 1, wherein the first substrate position and the fourth substrate position share an identical height position (H3), and the second substrate position and the third substrate position share an identical height position (H1).

7. The substrate transportation apparatus as defined in Claim 6, wherein

the holder moving unit comprises:

a feed elevation unit (42) for vertically moving the substrate feed holder; and

a discharge elevation unit (44) for vertically moving the substrate discharge holder,

the respective elevation units are operable to move each of the substrate feed holder and the substrate discharge holder vertically, so that the substrate feed holder and the substrate discharge holder are separately positioned at each of a first height position (H3) which is the height of the first substrate position and the fourth substrate position, a first retreat height position (H4) higher than the first height position, a second height position (H1) which is the height position of the second

substrate position and the third substrate position and a second retreat height position (H2) higher than the second height position.

8. The substrate transportation apparatus as defined in Claim 7, wherein the respective elevation units (42, 44) include two cylinder sections (42a, 42b, 44a, 44b) whose strokes are different from each other, the strokes of the respective cylinder sections being combined to achieve the vertical movement to the respective height positions.

9. A component mounting apparatus, comprising:

the substrate transportation apparatus as defined in any one of Claim 1 to Claim 8; and

a mounting head unit (20) for holding the respective components and mounting the held components on the substrate held by the substrate holding-and-moving device in the substrate mounting region.

10. A substrate transportation method in component mounting operation for positioning substrates (3) placed and held on a substrate holding base (28) at a substrate mounting region (P0) and mounting a plurality of components (2) on the substrates so as to offer the substrates as component-mounted substrates (3), in which the substrates are fed and discharged by using a substrate feed holder (36, 37) for releasably holding the substrates transported along a substrate-transportation direction and feeding the

substrates to the substrate holding base, and a substrate discharge holder (38, 39) for holding the component-mounted substrates held on the substrate holding base and discharging the substrates from the substrate holding base so as to put the substrates in a state transportable along the transportation direction, comprising:

holding, by the substrate feed holder, the substrate transported along the transportation direction to a first substrate position out of the first substrate position (P1), a second substrate position (P2), a third substrate position (P3) and a fourth substrate position (P4), each of which is assigned sequentially next to each other, and then positioning the held substrate at a height position (H2) located above the second substrate position, while positioning the substrate discharge holder at a height position (H2) located above the third substrate position;

moving the substrate holding base which is holding the component-mounted substrate in the substrate mounting region to the third substrate position;

discharging the substrate from the substrate holding base, by moving the substrate discharge holder downward, holding the component-mounted substrate, and moving the component-mounted substrate upward to the higher height position;

then moving the substrate holding base to the second substrate position;

feeding the substrate to the substrate holding base, by moving the substrate feed holder downward, and
5 releasing the holding state; and

moving the substrate holding base to which the substrate has been fed to the substrate mounting region, while moving the component-mounted substrate held by the substrate discharge holder to the fourth substrate position.

10 11. The substrate transportation method in component mounting operation as defined in Claim 10, wherein the movement operation for moving the component-mounted substrate held by the substrate discharge holder to the fourth substrate position is completed after the mounting
15 operation for mounting the components on the substrate fed to the substrate holding base is started in the substrate mounting region.

12. The substrate transportation method in component mounting operation as defined in Claim 10, wherein a speed
20 or an acceleration of the movement of the component-mounted substrate held by the substrate discharge holder to the fourth substrate position is smaller than a speed or an acceleration of the movement when the substrate discharge holder is not in a state of holding the component-mounted
25 substrate.

13. The substrate transportation method in component mounting operation as defined in Claim 10, wherein timing control is performed to hold, by the substrate feed holder, the substrate transported to the first substrate position so that almost as soon as the substrate holding base holding the component-mounted substrate is moved to and positioned at the third substrate position, the substrate feed holder holding the substrate and the substrate discharge holder are moved to and positioned at the height position (H2) at which the substrate holding base positioned at the third substrate position is avoidable.

14. The substrate transportation method in component mounting operation as defined in any one of Claims 10 to 13, wherein timing control is performed to hold, by the substrate feed holder, the substrate transported to the first substrate position based on a time (T_b) necessary for mounting the respective components on the substrate positioned in the substrate mounting region and offering the substrate as a component-mounted substrate and a time (T_s) necessary for holding, by the substrate feed holder, the substrate transported to the first substrate position and positioning the held substrate at a height position higher than the second substrate position in the component mounting operation.